

CLAIMS

Having thus described our invention in detail, what we claim as new, and desired to secure by the Letters Patent is:

- 1 1. A method of forming an interconnect structure
2 including a patterned anti-fuse dielectric layer formed
3 on surface of a substrate, said method comprising the
4 steps of:
5
6 (a) forming an anti-fuse dielectric layer on a surface of
7 a substrate, said substrate having a first level of
8 electrically conductive features;
9
10 (b) forming an interlevel dielectric layer on said anti-
11 fuse dielectric layer;
12
13 (c) forming vias in said interlevel dielectric layer
14 exposing portions of said anti-fuse dielectric layer that
15 overlay said first level of electrically conductive
16 features;
17
18 (d) forming a wire level mask on said interlevel
19 dielectric layer, wherein at least of one of said vias
20 and a portion of said interlevel dielectric layer are
21 left exposed;
22
23 (e) etching exposed portions of said anti-fuse dielectric
24 layer from said exposed vias, wherein during said etching
25 a portion of said exposed interlevel dielectric layer is
26 removed so as to form a space wherein a second level of

27 electrically conductive features will be subsequently
28 formed;

29
30 (f) stripping said wire level mask; and

31
32 (g) filling said vias including said spaces with a
33 conductive material, whereby said second level of
34 electrically conductive features is formed.

1 2. The method of Claim 1 wherein said first level of
2 electrically conductive features is formed by a single or
3 dual damascene process.

1 2
3 3. The method of Claim 1 wherein step (a) includes a
4 deposition process selected from the group consisting of
5 CVD, plasma-assisted CVD, sputtering and evaporation.

1 2
3 4. The method of Claim 1 wherein said anti-fuse
4 dielectric has a thickness of from about 2 to about 200
5 nm.

1 2
2 5. The method of Claim 4 wherein said anti-fuse
3 dielectric has a thickness of from about 5 to about 10
4 nm.

1 2
3 4
4 5
5 6. The method of Claim 1 wherein said anti-fuse
6 dielectric is a dielectric material selected from the
7 group consisting of SiO_2 , Si_3N_4 , Si oxynitrides, amorphous
8 Si, amorphous C, H-containing dielectrics, carbon,
9 germanium, selenium, compound semiconductors, ceramics
10 and anti-reflective coatings.

1 7. The method of Claim 6 wherein said anti-reflective
2 coating is a silicon oxynitride.

1 8. The method of Claim 1 wherein step (b) includes a
2 deposition process and, optionally, a planarization
3 process.

1 9. The method of Claim 8 wherein said deposition process
2 is selected from the group consisting of chemical vapor
3 deposition (CVD), plasma-assisted CVD, sputtering,
4 plating and evaporation.

1 10. The method of Claim 8 wherein said optional
2 planarization process includes chemical-mechanical
3 polishing (CMP) or grinding.

1 11. The method of Claim 1 wherein said interlevel
2 dielectric has a thickness of from about 0.1 about 2.0
3 μ m.

1 12. The method of Claim 1 wherein step (c) includes
2 lithography and etching.

1 13. The method of Claim 1 wherein step (e) includes
2 reactive-ion etching, ion-beam etching or plasma etching.

1 14. The method of Claim 1 wherein step (g) includes a
2 deposition process.

1 15. The method of Claim 14 wherein said deposition
2 process is selected from the group consisting of chemical

3 vapor deposition (CVD), plasma-assisted CVD, sputtering,
4 plating and evaporation.

1 16. The method of Claim 1 further comprising a
2 planarizing step after step (g).

1 17. The method of Claim 1 wherein between steps (f) and
2 (g) a barrier layer is applied in said vias and spaces.

1 18. The method of Claim 1 wherein said vias are slot
2 vias, stacked vias, standard vias or any combinations
3 thereof.

1 19. The method of Claim 1 further comprising forming
2 additional interconnect levels to said filled structure
3 provided in step (g).

1 20. The method of Claim 1 further comprising repeating
2 steps (a)-(g) any number of times to provide a multilevel
3 interconnection structure wherein each successive level
4 includes a patterned anti-fuse material formed thereon.

1 21. The method of Claim 1 further comprising forming a
2 second interlevel dielectric layer on the structure
3 provided in step (g), forming a tapered opening in said
4 second interlevel dielectric level exposing the filled
5 conductive vias and spaces; forming a second conductive
6 material in said tapered opening; and reactive-ion
7 etching said second conductive material.

1 22. An interconnect structure in which an anti-fuse
2 dielectric is formed therein comprising:

3 a substrate having a first level of electrically
4 conductive features;
5
6 a patterned anti-fuse dielectric layer formed on said
7 substrate, wherein said patterned anti-fuse dielectric
8 layer includes an opening to at least one of said first
9 level of electrically conductive features;
10
11 a patterned interlevel dielectric material formed on said
12 patterned anti-fuse dielectric layer, wherein said
13 patterned interlevel dielectric includes vias, as least
14 one of said vias has a via space formed above said
15 opening; and
16
17 a second level of electrically conductive features formed
18 in said vias and via spaces.

1 23. The interconnect structure of Claim 22 wherein said
3 substrate is composed of an interlevel dielectric
4 material that is the same or different from said
5 patterned interlevel dielectric material.

1 24. The interconnect structure of Claim 22 wherein said
2 patterned interlevel dielectric material is composed of
3 an inorganic semiconductor material selected from the
4 group consisting of SiO_2 , Si_3N_4 , diamond, diamond-like
5 carbon and fluorinated doped oxides.

1 25. The interconnect structure of Claim 22 wherein said
2 patterned interlevel dielectric material is composed of
3 an organic dielectric material selected from the group

4 consisting of polyimides, polyamides, paralyene and
5 polymethylmethacrylate.

1 26. The interconnect structure of Claim 22 wherein said
2 first and second levels of electrically conductive
3 features are composed of the same or different conductive
4 metal selected from the group consisting of aluminum,
5 tungsten, copper, chromium, gold, platinum, palladium and
6 alloys, mixtures and complexes thereof.

1 27. The interconnect structure of Claim 22 wherein said
2 anti-fuse dielectric layer is a dielectric material
3 selected from the group consisting of SiO_2 , Si_3N_4 , Si
4 oxynitrides, amorphous Si, amorphous C, H-containing
5 dielectrics, carbon, germanium, selenium, compound
6 semiconductors, ceramics and anti-reflective coatings.

1 28. The interconnect structure of Claim 27 wherein said
2 anti-reflective coating is silicon oxynitride.

1 29. The interconnect structure of Claim 22 wherein
2 another interconnect level is formed over said patterned
3 interlevel dielectric layer.

1 30. The interconnect structure of Claim 29 wherein said
2 another interconnect level includes a tapered metal
3 contact region.